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Bridges over Troubled Waters – An Interdisciplinary Framework for Evaluating the Interconnectedness within Fragmented Domestic Flood Risk Management Systems

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³ This paper has been written in the framework of the European Union’s Seventh Programme for Research, Technological Development and Demonstration within the STAR-FLOOD project (www.starflood.eu).

Bridges over Troubled Waters – An Interdisciplinary Framework for Evaluating the Interconnectedness within Fragmented Domestic Flood Risk Management Systems

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ABSTRACT – Diversification of strategies in Flood Risk Management (FRM) is widely regarded as a necessary step forward in terms of lessening the likelihood and magnitude of flooding, as well as minimizing the exposure of people and property, and in turn the disruption, economic damage, health impacts and other adverse consequences that ensue when floods occur. Thus, diversification is often heralded as an essential condition for enhancing societal resilience to flooding. However, an inevitable consequence of diversifying strategies and practices in FRM is that it can lead to fragmentation within FRM systems, in terms of the distribution of responsibilities between actors and governing rules enacted within different policy domains. This can prove detrimental to the effectiveness of FRM.

Building upon the notion of fragmentation developed in legal and governance literature, this paper introduces the concept of ‘bridging mechanisms’, i.e. instruments that remedy fragmentation by enhancing interconnectedness between relevant actors through information transfer, coordination and cooperation. This paper develops a typology of both fragmentation and bridging mechanisms and analyzes their relations, partly drawing upon empirical research conducted within the EU ‘STAR-FLOOD’ project. In turn, this paper outlines a novel interdisciplinary methodological framework for evaluating the degree and quality of the interconnectedness within fragmented domestic FRM systems. A pragmatic, flexible and broadly applicable tool, this framework is both suited for academic purposes, as well as for practically oriented analysis and (re)development of fragmented FRM systems, and potentially other fragmented systems, within the EU and abroad.

KEY WORDS – Bridging mechanisms; cooperation; coordination; diversification; evaluation framework; flood risk management; fragmentation; interconnectedness; information transfer; societal resilience

1. Introduction

EU policy and legislation on Flood Risk Management (FRM) aim at the reduction of the adverse consequences of floods for human health, the environment, cultural heritage and economic activity.⁷ In order to achieve this central aim, in the literature, five potential

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⁶ This paper has been written in the framework of the European Union’s Seventh Programme for Research, Technological Development and Demonstration within the STAR-FLOOD project (www.starflood.eu).

⁷ See COM(2004) 472 and Article 1 FD. Also see Barredo 2007; Van Rijswijk & Havekes 2012; and Gilissen 2014.

strategies have been distinguished, namely *prevention*, *defense*, *mitigation*, *preparation & response*, and *recovery* following floods.⁸ ⁹ Defense and mitigation strategies lessen the likelihood and magnitude of flooding through the use of measures that act to resist (e.g. dykes) or accommodate (e.g. flood storage areas, adaptive building) water, respectively.¹⁰ Accompanying this, the prevention strategy aims to minimize the exposure of people and property to flooding, for example, through the use of spatial planning conditions (e.g. building restrictions).¹¹ At a time where it must be accepted that not all floods can be prevented everywhere, the strategies for preparation & response and recovery employ a range of measures that aim to lessen the adverse consequences that ensue when floods occur, such as emergency management and insurance or compensation mechanisms, respectively.¹²

It has generally been assumed that effectively implementing each of the five FRM strategies and moving beyond defense-dominated approaches – also referred to as *diversification* – increases societal resilience to flooding.¹³ Research into domestic FRM systems shows that diversification is institutionalized to varying degrees throughout the EU.¹⁴ However, such diversification has resulted in different degrees of *fragmentation*, with FRM strategies implemented through different policy domains and by various actors with different responsibilities and competences.¹⁵ The assumption upon which this paper builds, then, is that enhancing *interconnectedness* within a fragmented FRM system (i.e. creating or intensifying interactions between all relevant actors) is essential to cope with the difficulties relating to fragmentation, and thus will benefit the effectiveness of FRM.¹⁶ The specific instruments through which this is done in this paper are referred to as *bridging mechanisms*.¹⁷ Indeed, a wide range of (types of) bridging mechanism can be discerned throughout the EU, mostly aimed at sharing information, coordination of policies and cooperation. Although specific examples of bridging mechanisms, such as the ‘Water Test’ or instruments alike,

⁸ See Meijerink & Dicke 2008, pp. 500-501; Havekes & Van Rijswijk 2012, p. 251; and Hegger et al. 2014, pp. 4127-4128. All FRM strategies contribute to the achievement of the central aim through specific types of measures. The flood risk prevention strategy, for instance, can be implemented through restrictive land use policies (e.g. ‘construction bans’ for flood prone areas), whereas a typical example of a defence measure is the construction of a dike. There is no hierarchical relation between FRM strategies (at least not on the basis of EU policy and legislation); Member States are left much policy discretion as to the decision which strategies to implement in which way within their domestic FRM frameworks.

⁹ Note that the Floods Directive discerns only three out of five strategies: prevention, protection (defense) and preparation. See COM(2004) 472, p. 4 and Consideration 14 of the Preamble to the FD.

¹⁰ See Hegger et al. 2014.

¹¹ See Hegger et al. 2014.

¹² See Gilissen et al. 2016a (prevention & response); and Suykens et al. 2016 (recovery).

¹³ See Aerts et al. 2008; Hegger et al. 2013 ; Larrue et al. (eds.) 2013a; Larrue et al. (eds.) 2013b; and Hegger et al. 2014.

¹⁴ See Alexander et al. 2015; Ek et al. 2015; Kaufmann et al. 2015; Larrue et al. 2015; Matczak et al. 2015; and Mees et al. 2015.

¹⁵ None of the selected countries have implemented their specific combination of FRM strategies into one fully integrated ‘governance arrangement’ with a clearly demarcated set of actors, rules and resources. Most domestic FRM systems comprise a number of distinct (sub-)arrangements instead. For further reading, see Liefverink 2006; and Larrue et al. (eds.) 2013b.

¹⁶ See, for instance, Matczak et al. 2016, pp. 33-34.

¹⁷ The term ‘bridging mechanisms’ has emerged within the framework of the STAR-FLOOD Project. Within this project, different approaches to this notion have been developed (see, for instance, Matczak et al. 2016, pp. 33-34). On a first glance, these seem to highly differ. Nonetheless, these have the same conceptual basis and do not internally contradict; they are rather to be treated as ‘different views of the cathedral’.

have already been examined in (domestic) literature,¹⁸ there is not yet a consistent typology, nor a coherent framework for the evaluation of the desirable effects and effectiveness of such instruments. This paper contributes to the development thereof.

For this purpose, this paper builds upon results of cross-disciplinary research carried out within the ‘STAR-FLOOD’ project, which examined flood risk governance arrangements across six EU Member States,¹⁹ from legal, public administration and policy perspectives. It draws from the results of qualitative analysis of domestic FRM governance arrangements and positive legal analysis of relevant primary and secondary legal sources. These findings were further enriched by semi-structured interviews with past and current FRM experts, analyzed according to qualitative thematic analysis.²⁰ On the basis of this rich body of data and further theoretical reasoning, this paper first introduces a typology of and elaborates upon the concept of fragmentation and its related difficulties (Section 2). Thereafter, the paper addresses the concepts of bridging mechanisms and interconnectedness (Section 3). Empirical data concerning the degrees and types of fragmentation and bridging mechanisms are presented in Section 4 by virtue of an exemplification of the previous sections. Addressing a knowledge gap and for the purpose of facilitating future (comparative) research, Section 5 of this paper outlines a novel interdisciplinary methodological framework for structured in-depth evaluations of the degree and quality of interconnectedness within fragmented domestic FRM systems. The paper concludes with key findings and an open invitation for future research (Section 6).

2. Fragmentation

The concept of fragmentation has been the focus of international legal research for almost two decades.²¹ Soon after its emergence, this concept was also adopted by other disciplines, such as global (environmental) governance.²² Fragmentation is commonly defined as the situation in which a ‘governance architecture’ is not regulated or dominated by a single (international) regime,²³ but instead is “marked by a patchwork of international institutions that are different in their character (organizations, regimes, and implicit norms), their constituencies (public and private), their spatial scope (from bilateral to global), and their subject matter (from specific policy fields to universal concerns)”.²⁴

¹⁸ See, for instance, Groothuijse & Van Rijswijk 2005; Groothuijse 2009; Van Rijswijk & Havekes 2012; Denys & Toury 2012; Ameloot 2013; Carette & De Smedt 2013; Gilissen, Kevelam & Van Rijswijk 2014; OECD 2014; Van Rijswijk 2014; Kaufmann et al. 2015; Mees et al. 2015; Alexander et al. 2015; Larrue et al. 2015; and Matczak et al. 2015.

¹⁹ The Member States participating in this project were Belgium, England (UK), France, the Netherlands, Poland, and Sweden. Sweden, for practical reasons, was excluded from this paper. The remaining countries, hereinafter, are referred to as ‘the selected countries’.

²⁰ See Cassell & Symon (eds.) 2004.

²¹ See, for instance, Hafner 2000; Koskeniemi & Leino 2002; Hafner 2004; ILC 2006; Martineau 2009; and Fauchald & Nollkaemper (eds.) 2012.

²² See, for instance, Bernstein & Ivanova 2007; Biermann et al. 2009; Zelli 2011; and Zelli & Van Asselt 2013.

²³ The term ‘global governance architectures’, nowadays, is a key term in literature about fragmentation. It is defined as “the overarching system of public and private institutions that are valid or active in a given issue area of world politics. This system comprises organizations, regimes, and other forms of principles, norms, regulations, and decision-making procedures.” See Biermann et al. 2009, p. 15.

²⁴ See Biermann et al. 2009, p. 16.

Fragmentation, at first, had a negative connotation, as it was argued it could, for instance, lead to legal uncertainty, threats to the “credibility, reliability and, consequently, authority of international law”, and could negatively affect its effectiveness.²⁵ Over time, most of this negativity was soothed. The consequences of fragmentation were rather framed as ‘difficulties’ or ‘challenges’ instead of ‘problems’ or ‘risks’, and fragmentation itself was viewed as an inevitable result of intrinsically positive developments, such as diversification and expansion of (international) regimes.²⁶

Unsurprisingly, most global governance architectures are fragmented, although the degree of fragmentation is varied.²⁷ Less frequently, the concept of fragmentation is cut loose from its international environment and – in a somewhat or heavily altered form – transplanted into an EU, domestic or regional context.²⁸ Also at these levels, different degrees and types of fragmentation seem to be omnipresent. This paper is situated in this context and focuses on the degree (Section 2.1) and types (Section 2.2) of fragmentation evident in domestic FRM systems in selected EU Member States.

2.1. The degree of fragmentation

To get a better view into fragmentation as one of this paper’s key concepts, a number of central terms needs to be exemplified. For the purpose of this paper, the term *Flood Risk Management (FRM) system* is conceptualized as the overarching domestic institutional system, comprising all (types of) actors, values, principles, norms, rules, regulations, and procedures relating to flood risk management.²⁹ Flood risk management, in turn, refers to all (types of) activities that address the exposure, hazard and consequences of flood risk, enacted through the five FRM strategies previously mentioned.³⁰ The key players within FRM systems – in this paper referred to as *actors* – can be public or private entities, organizations, departments, groups or even individuals which have been assigned a specific set of FRM related responsibilities and competences, either legally established through statutes or custom, or else encouraged through public policy. Hence, actors are primarily to be distinguished by their specific responsibilities and competences in their pursuit of certain FRM strategies.

All actors contribute to the achievement of the same overall objective (i.e. effective FRM), but they can only make use of the specific competences and instruments at their disposal, and they can only be held legally accountable for the fulfillment of the specific tasks that have been imposed on them. The *degree* of fragmentation of an FRM system could, then, be

²⁵ See Hafner 2004 (quotation at p. 35); Ambrus et al. 2014; and Kotzé 2014.

²⁶ See Simma 2004. This ‘neutral’ approach is also at the basis of this paper.

²⁷ See Biermann et al. 2009, pp. 17-18. Biermann et al. distinguish between three degrees of fragmentation (Biermann et al. 2009, pp. 19-21): synergistic fragmentation (high level of integration), cooperative fragmentation (more loosely integrated), and conflictive fragmentation (no integration). In this respect, ‘full integration’ can be seen as the opposite of fragmentation.

²⁸ See, for instance, Edler & Kuhlmann 2008; Bakker & Cook 2011; and Ambrus et al. 2014.

²⁹ This definition is – not coincidentally – based on the term ‘global governance architectures’. See Biermann et al. 2009, p. 15.

³⁰ These are, hereinafter, in short referred to as 1) prevention, 2) defence, 3) mitigation, 4) preparation & response, and 5) recovery. See Van Rijswick & Havekes 2012, p. 251; and Hegger et al. 2014.

determined by assessing the quantity of involved actors with distinct responsibilities and competences in the pursuit of FRM strategies. If all responsibilities and competences relevant to FRM – in a hypothetical situation – are assigned to a single omnipotent actor, the system is not fragmented, but fully integrated. The more actors have closely related or even overlapping responsibilities and competences in the pursuit of FRM strategies, the higher is the degree of fragmentation (see Figure 1). However, this does not say much about the *types* of fragmentation and their related difficulties (see Section 2.2).

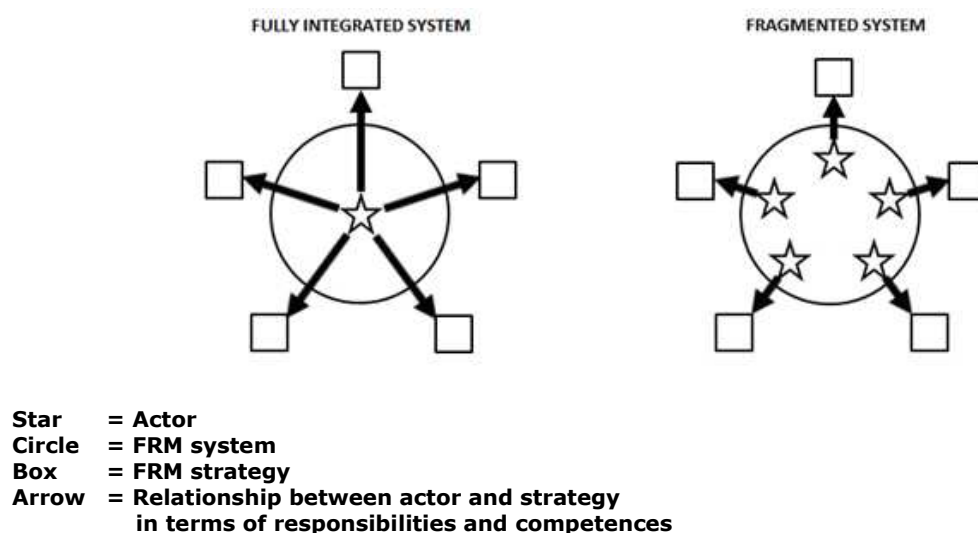


Figure 1: Fully integrated as opposed to fragmented (FRM) systems

2.2. Four types of fragmentation

Distinguishing types of fragmentation adds much complexity to this concept, but is necessary for the purpose of this paper. Analyzing the *degree* of fragmentation could, after all, only determine the number of bridging mechanisms needed and their preferred points within the FRM system (i.e. the *degree* of interconnectedness within an FRM system; see Section 3.2). Determining the *type* of fragmentation could determine whether there is a relation between specific types of bridging mechanisms and specific types of fragmentation, which is far more informative, as this is useful for evaluating the *quality* of the interconnectedness within FRM systems (see Section 3.3). Based on the policy domains in which actors operate³¹ and the FRM strategies they pursue, a distinction can be made between four basic types of fragmentation. These are schematically depicted in Figure 2.³²

³¹ A policy domain is defined as a delimited and coherent institutional system of actors, values, principles, norms, regulations and procedures, and – for the specific purpose of this paper – in which actors bear certain responsibilities and competences relating to one or more FRM strategies. Note the similarities and differences between the definitions of the terms ‘FRM system’ and ‘policy domain’. There, indeed, is a close relation between both concepts. The FRM system of a country is constituted by all distinct policy domains in which actors bear responsibilities and competences relating to FRM. Most countries’ FRM systems are not policy domains in themselves, as they lack institutional delimitation and coherence and are ‘shattered’ over different policy domains.

³² Approaching the concept from a different perspective, this distinction essentially differs from the one Biermann et al. (2009) make.

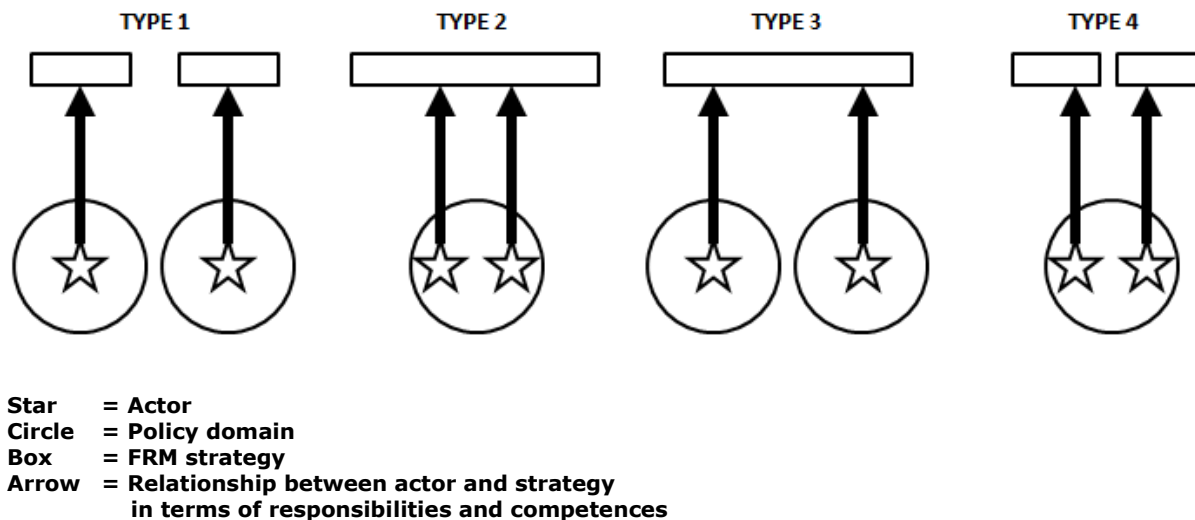


Figure 2: Four types of fragmentation³³

These four types of fragmentation, hereinafter, are referred to as ‘Type 1’, ‘Type 2’, ‘Type 3’, and ‘Type 4’ fragmentation, respectively. Below, these four types are explained and illustrated through simple examples. It should be kept in mind, however, that these types of fragmentation represent the most simplified situations possible; these are based on sets of two actors. In practice, combinations of fragmentation types are present and regularly multiple (sets of) actors are involved. In fact, every fragmented FRM system could be considered a complex combination of fragmentation types.

Type 1 fragmentation refers to situations in which distinct actors operating in different policy domains pursue different FRM strategies. Example: Water Management Authority A operates within the distinct Water Resources Management domain and pursues the defense strategy. Spatial Planning Authority B operates within another domain (Spatial Planning) and pursues the mitigation strategy.

Type 2 fragmentation refers to situations in which distinct actors operating in the same policy domain pursue the same FRM strategy. Example: Emergency Management Authority C operates within the Emergency Management policy domain and pursues the preparation & response strategy. At the same time, also Emergency Service D and Utility Provider E operate within that domain and have certain responsibilities in the pursuit of the preparation & response strategy.

Type 3 fragmentation refers to situations in which distinct actors operating in different policy domains pursue the same FRM strategy. Example: Water Management Authority F and Emergency Management Authority G operate within different policy domains (Water Resources Management and Emergency Management, respectively). Nonetheless, within the framework of those distinct domains, they have specific responsibilities and competences in the pursuit of the preparation & response strategy.

³³ Note that the circle in Figure 2 represents a policy domain, where in Figure 1 it represents an FRM system.

Type 4 fragmentation refers to situations in which distinct actors operating in the same policy domain pursue different FRM strategies. Example: Water Management Authority H and Spatial Planning Authority I operate within one overarching policy domain ('Management of the Living Environment'). Nonetheless, the one bears only responsibilities for the pursuit of the defense strategy, whereas the other is exclusively responsible for mitigation.

3. Bridging mechanisms and interconnectedness

As stated before, this paper builds upon the assumption that enhancing interconnectedness within fragmented FRM systems (i.e. creating or intensifying effective interrelations between relevant actors at relevant points within the system) benefits the effectiveness of FRM.³⁴ The instruments used for this purpose, here, are referred to as bridging mechanisms. The term bridging mechanisms is conceptualized as all kinds of inter-linkages between sets of actors, aiming to intensify interactions in their pursuit of various FRM strategies in order to cope with the difficulties relating to fragmentation. As these difficulties are varied, also different types of bridging mechanisms can be distinguished (Section 3.1). Apart from having proper types of bridging mechanisms in place at relevant points within an FRM system, bridging mechanisms should also be effective themselves in order to foster effectiveness of FRM. In other words, both the *degree* (Section 3.2) and the *quality* (Section 3.3) of interconnectedness are important indicators for the effectiveness of fragmented FRM systems, and thus constitute a basis for the evaluation of such systems.

3.1. Three types of bridging mechanisms

As bridging mechanisms have been defined as inter-linkages between actors in order to cope with the potential difficulties relating to fragmentation, it is of primary importance to first identify and specify these potential difficulties. In this respect, three types of situations can immediately be discerned. These are 1) situations in which the one actor lacks and the other actor has information or experience which is needed for policy-making in the pursuit of a specific FRM strategy for which the former actor is responsible; 2) situations in which the policies of an actor in the pursuit of a specific FRM strategy can hinder another actor in the pursuit of the same or another strategy (or otherwise (negatively) influence its policy-making); and 3) situations in which actors pursue the same FRM strategy, whilst on the basis of their distinct competences none of them is capable of achieving their goal without the efforts of the other.

Having identified these three types of difficulties, a next step is to identify 'solutions' that can mitigate their adverse effects. This leads to the identification of three types of bridging mechanisms (see Table 1). A lack of information or experience requires information flows from the actor who has the relevant information towards the actor who needs this information in order to make a proper and well-informed (policy) decision. These types of bridging mechanisms, in this paper, are referred to as information and/or experience transferring

³⁴ See, for instance, Matczak et al. 2016, pp. 33-34.

mechanisms or, in brief, *transfer* mechanisms.³⁵ The second difficulty requires some kind of alignment between the policies of both actors, in order to keep them both informed about their performance of duties, preventing their policies to be at odds and/or become impossible to implement. Such bridging mechanisms are referred to as *coordination* mechanisms.³⁶ In the third situation-type both actors are dependent on each other for achieving their shared goals, which leads to the need for joint policies and/or working or, in terms of this paper, the need for *cooperation* mechanisms.³⁷ It should be kept in mind that, in practice, these types of bridging mechanisms can have many different appearances,³⁸ both regarding their degree of formality, and their intensity and form of interaction.

Type of difficulty	Type of bridging mechanism
Lack of relevant information/experience	Transfer
One policy can hinder another	Coordination
Mutual dependence in goal achievement	Cooperation

Table 1: Types of difficulties relating to fragmentation and types of bridging mechanisms for resolving these difficulties

As a closing remark, while bridging mechanisms aim to mitigate the (inevitable) difficulties relating to fragmentation, it should be kept in mind that there are also other ways to resolve fragmentation. These do not aim at ‘managing its symptoms’ through creating or intensifying interactions between actors, but at combatting the degree of fragmentation itself. Such interventions do not meet the definition of bridging mechanisms presented in this paper and should therefore not be considered as such. Nonetheless, they are worth mentioning, because they are to be considered potential additional or even alternative strategies in coping with fragmentation and practice provides some interesting examples.³⁹ In particular, one can think of three types of systemic changes. These are 1) the integration of policy domains, 2) the integration of strategies, for instance, by adopting overarching standards, and 3) the transferal of tasks, responsibilities and competences from one actor to another.⁴⁰ The former two interventions mainly induce a shift from the one type of fragmentation to another, whereas the latter actually reduces the degree of fragmentation.

³⁵ Transfer mechanisms can have ‘one-way’ or ‘two-way’ (or even ‘multiple-way’) effects, aiming at information transfer or exchange respectively. Examples of transfer mechanisms are inter-organizational communication and other information-sharing or exchange structures, such as shared databases or maps, but also consulting or advisory mechanisms.

³⁶ Examples of coordination mechanisms are (general or specific) duties to align policies, duties to take certain policies into account in other policy or decision-making procedures, but also vertical (top-down) steering mechanisms, such as inter-governmental instructions.

³⁷ Examples of cooperation mechanisms are (general or specific) duties to cooperate, inter-governmental agreements, shared policies, covenants, and joint working structures.

³⁸ One could even think of ‘combined mechanisms’, such as mechanisms that aim at both generating information flows and cooperation between actors.

³⁹ A clear example is the Dutch Environmental Planning Act, which intendedly is to enter into force by 2018. This Act integrates a number of policy domains (e.g. water management, spatial planning, environmental protection, archeology, and monuments conservation) into one legal and policy framework. There still will be several actors responsible for specific aspects of environmental protection in a broad sense, but this act also provides for the possibility to formulate shared objectives referred to as ‘*omgevingswaarden*’. The entry into force will not lead to a fully integrated FRM system, but (in terms of this paper) will effectuate a shift from ‘Type 1’ fragmentation to ‘Type 4’ fragmentation. For closer reading, see (for instance) Nijenhuis 2014; and Nijmeijer 2014.

⁴⁰ This former actor can be an existing actor (for instance an organ of a municipality), but also a newly established actor. Dutch Security Regions can, for instance, be considered newly (2010) established actors.

3.2. The degree of interconnectedness: are proper types of bridging mechanisms present at relevant points?

After having identified three types of bridging mechanisms, the degree of interconnectedness is to be addressed. The degree of interconnectedness of a fragmented FRM system can be considered optimal if all proper types of bridging mechanisms are present at all relevant points within the system. Relevant points can easily be determined through identifying all actor sets within a system; these are the points on which difficulties relating to fragmentation potentially emerge, because actors ‘meet’ each other there. The main question, thus, remains which types of bridging mechanisms are to be considered appropriate under specific circumstances. Whereas these specific circumstances are mainly determined by the types of fragmentation and their related potential difficulties, Table 2 gives an overview of the types of bridging mechanisms that should be present at a relevant point within a fragmented FRM system given a certain type of fragmentation. On the basis of this table, for all relevant points/identified actor sets the appropriate combination of types of bridging mechanisms can be determined.

	Type 1	Type 2	Type 3	Type 4
Lack of information/experience	Transfer	Transfer	Transfer	Transfer
One policy hinders another	Coordination	Coordination	Coordination	Coordination
Mutual dependency	N/A	Cooperation	Cooperation	N/A

Table 2: Types of bridging mechanisms to be present at relevant points within a fragmented FRM system given certain types of fragmentation.

On the basis of Table 2, both transfer and coordination mechanisms should in principle be present under all types of fragmentation. This can be explained by the fact that a lack of information or experience or a clash of policies can emerge regardless of whether relevant actors operate within the same policy domain or pursue the same FRM strategy. Only when actors do pursue the same FRM strategy – irrespective of whether they operate within the same policy domain – a cooperation mechanism should in principle be in place in order to deal with their mutual dependency in the pursuit of their shared strategy (‘Type 2’ and ‘Type 3’ fragmentation). As there will be no evident mutual dependency between actors in the pursuit of different FRM strategies, there is no direct need for cooperation mechanisms under such circumstances (‘Type 1’ and ‘Type 4’ fragmentation). From the perspective of potential difficulties, ‘Type 2’ and ‘Type 3’ fragmentation can, thus, be considered as more ‘complex’ than the other two types, requiring a wider range of specific types of bridging mechanisms.

3.3. The quality of interconnectedness: are the identified bridging mechanisms effective themselves?

Apart from the degree of interconnectedness, also its quality is a key indicator for the effectiveness of FRM. To get an overall view of the quality of the interconnectedness within an FRM system, the effectiveness of all bridging mechanisms present within an FRM system should be evaluated separately. Apart from describing these mechanisms and especially their specific goals in more detail, such an evaluation should follow a pre-determined and pre-

operationalized set of indicators and/or benchmarks, and – in addition to desk studies – may require stakeholder/expert involvement through interviews and focus group sessions.⁴¹ Inspired by interdisciplinary research about the effectiveness of responsibilities for climate adaptation in vulnerable network sectors, suggested indicators for the effectiveness of bridging mechanisms are their explicitness/transparency, enforceability/compliance, and legitimacy/support.⁴² Given the interdisciplinary approach of this paper, also the suggested indicators are of a ‘mixed’ nature, comprising legal and governance aspects.

In order to meet the first criterion (explicitness/transparency), the responsibilities relating to bridging mechanisms, as to their specific goals and application, should be formulated as clear and detailed as possible, in order to provide an optimal degree of legal certainty. It does not matter whether this is done through legislation or guiding, explanatory or policy documents, as long as all responsibilities are knowable (who is responsible?) and clear (what does this responsibility imply?) to all relevant actors and other potentially interested parties. Moreover, a bridging mechanisms especially established for specific FRM purposes can be considered more explicit than very generally formulated and applicable mechanisms aiming at, for instance, the coordination of an unspecified number of tasks.⁴³

Responsibilities should not only be knowable and clear, but should also be enforceable. This means that effective instruments should be in place to force relevant actors to comply with their (mutual) responsibilities. One could think of court procedures, mediation tracks, or other dispute settlement constructions, but also of inter-administrative supervisory structures, penalty or liability systems, or even naming and shaming constructions. Regarding their formalized nature, statutory bridging mechanisms can be expected to be better enforceable than informal bridging mechanisms. This, however, is not to say that informal bridging mechanisms by definition are less effective than their statutory counterparts.⁴⁴

The latter indicator requires the responsibilities resulting from bridging mechanisms to be legitimate in legal terms (democratically legitimate) and also to be conceived as legitimate (or supported) by the relevant actors. This means that bridging mechanisms should have been developed under legitimate legal conditions (e.g. a proper (democratic) legislative process, taking into account all relevant interests), and that relevant actors and other potentially interested parties should properly have been involved, have had a chance to actively participate, in the development thereof. Moreover, this indicator requires that the responsibilities resulting from bridging mechanisms are – from a more subjective perspective – considered reasonable and acceptable by those who are responsible and accountable.⁴⁵

⁴¹ See, for instance, Morgan 1996; Wilson 2012a; Wilson 2012b; Säynäjoki et al. 2014; and Runhaar et al. 2015, pp. 8-9.

⁴² See Runhaar et al. 2014; Gilissen et al. 2015; Runhaar et al. 2015; and Gilissen et al. 2016b. Also see Adger et al. 2005; Van Rijswijk & Salet 2012; Van Buuren et al. 2014; Hegger et al. 2014; Mees et al. 2014; and Pettersson et al. 2016.

⁴³ See Buijze 2013; Mees et al. 2014; Runhaar et al. 2015, pp. 4 and 8-10; Gilissen et al. 2015, pp. 1643-1644 and 1646-1647; Van den Broek 2015; and Gilissen et al. 2016b, pp. 7-8.

⁴⁴ See Blomberg & Michiels 1997; Jans et al. 2007; and Buijze 2009.

⁴⁵ See Bekkers & Edwards 2007; Mees et al. 2014; Runhaar et al. 2015, pp. 4 and 8-9; and Gilissen et al. 2015, pp. 1644 and 1647.

4. Country analyses: examples from empirical research

The above sections give theoretical – and admittedly rather abstract – insight into the concepts of fragmentation, bridging mechanisms and interconnectedness, and the relations between these concepts. In this section, empirical data are presented about the degree and specific types of fragmentation, as well as about different types of bridging mechanisms in the five selected countries' FRM systems. In doing so, we do not intend to give a full view of the domestic situations, but rather intend to further substantiate and exemplify the concepts discussed above and to give an impression of the degree and types of fragmentation and the bridging mechanisms present in the selected countries. Thus, we intend to stimulate further in-depth research into these (and other) countries' FRM systems. As stated in the introduction of this paper, the data presented here result from empirical research conducted within the EU project 'STAR-FLOOD'. These data, however, as results of the broader research project, were also in part at the basis of the development of these concepts as such (also see Section 1). In turn, these conceptual and empirical data are also at the basis of the evaluation framework presented in Section 5 of this paper.

4.1. The degree and types of fragmentation in the selected countries

Unsurprisingly, all selected domestic FRM systems show a certain degree of fragmentation, as in all countries distinct actors within distinct policy domains have distinct responsibilities and competences in the pursuit of distinct FRM strategies (see examples in Tables 3.1 to 3.5). Hence, also different types of fragmentation are present within the selected countries' FRM systems (see Tables 4.1 to 4.5). As an in-depth description of all domestic situations does not suit the scope of this paper,⁴⁶ a number of particularities, similarities and differences are discussed below. Although also other policy domains are relevant in relation to FRM, the focus below is on the domains of water management, spatial planning and emergency management.

First focusing on the *degree* of fragmentation, there are striking differences as to the distinction between relevant policy domains in which actors bear responsibilities and competences for the pursuit of FRM strategies. This is important for determining the degree (and types) of fragmentation of a domestic FRM system. In France, for instance, five relevant policy domains are distinguished in which a specialized actor bears responsibilities for multiple strategies, resulting into multiple actors operating in different policy domains being partly responsible for the pursuit of the same strategy (see Table 3.3). In England, for the purpose of this paper, three policy domains are distinguished, but responsibilities for the pursuit of their corresponding FRM strategies are divided between a large number of actors within those domains (see Table 3.1). In Poland, the Flemish Region (Belgium) and the Netherlands, also three policy domains are distinguished in which one or a few actors bear responsibilities for a single or a limited number of FRM strategies (see Tables 3.2, 3.4 and 3.5). As the number of actors per policy domain in these countries is limited and the responsibilities for certain strategies are rather straightforwardly divided per policy domain,

⁴⁶ For more in-depth analyses, see Alexander et al. 2015; Kaufmann et al. 2015; Larrue et al. 2015; Matczak et al. 2015; Mees et al. 2015; and Matczak et al. 2016.

the degree of fragmentation in England and France is considerably higher than in the other countries.

Focusing on *types* of fragmentation, a first finding is that all countries' emergency management arrangements can be considered a form of 'Type 2' fragmentation (see Tables 4.1 to 4.5). Although these arrangements substantively vary (mainly as to the division of responsibilities between distinct actors or actor groups), they have in common that they all constitute a distinct policy domain in which distinct (groups of) actors pursue the same FRM strategy (preparation & response). In England, in this respect, a statutory division is made between coordinating government departments, Category 1 Responders (mainly emergency services), Category 2 Responders (e.g. utility services), and the voluntary sector. In the other countries, a distinction is made between specialized Emergency Management Authorities (at different levels and of different compositions) and emergency services, and in some cases utility services and the voluntary sector.⁴⁷ In the Netherlands, Poland and England, also actors within other policy domains have certain responsibilities in the pursuit of the preparation & response strategy.⁴⁸ This is, however, to be considered a form of 'Type 3' fragmentation (see Tables 4.1, 4.4 and 4.5).

Also other types of fragmentation are present within the FRM systems of the selected countries. However, in none of the countries 'Type 4' fragmentation can be discerned (see Tables 4.1 to 4.5). This type of fragmentation, thus, seems to be rare. In the Netherlands, however, a form of 'Type 4' fragmentation is emerging, as the intended legal integration of the policy domains of Water System Management and Spatial Planning into the single policy domain of 'Environmental Planning' will lead to a situation in which two distinct actors (SPAs and WMAs) will pursue different strategies (prevention/mitigation and defense, respectively) while operating within the same policy domain.⁴⁹ Forms of 'Type 1' fragmentation are the most common and eminent in Poland, the Flemish Region (Belgium) and the Netherlands, as in these countries a rather strict distinction is made between policy domains, corresponding strategies and (single) actors who bear responsibilities in this respect (see Tables 4.2, 4.4 and 4.5).⁵⁰ Due to the specific degrees of fragmentation in England and France (see above), in these countries 'Type 2' and 'Type 3' fragmentation are more common, respectively (see Tables 4.1 and 4.3). The selected policy domains in England, after all, show a wide range of actors that pursue the same strategy, while in France, a wide range of actors operating in different policy domains pursue the same strategy with different means.

⁴⁷ See, for instance, Brainich & Helsloot 2014; and Muller 2014.

⁴⁸ See, for instance, Havekes & De Putter 2014, pp. 161-168.

⁴⁹ For closer reading, see (for instance) Nijenhuis 2014; and Nijmeijer 2014.

⁵⁰ Flemish water management, however, includes several water managers, respectively the Department of Mobility & Public Works for navigable watercourses, the Flemish Environment Agency for non-navigable watercourses 1st category, the provinces for non-navigable watercourses 2nd category and the municipalities for non-navigable watercourses 3rd category (although since 2014, most 3rd category watercourses are under the auspices of the provinces). At locations where a polder or wateringue is still active, the management of 2nd and 3rd category non-navigable watercourses is under their charge. For the sake of clarity, these have been classified under the policy domain water management. Coordination between these water managers happens through the Coordination Committee on Integrated Water Policy (Decree Integral Water Policy 2003) on the basis of the 2003 DIWP, which strives for integrated water management, and thus pertains to management of water resources, spatial planning, and so forth.

Lastly, two particular forms of fragmentation deserve to be mentioned here. In the Flemish Region (Belgium), the Netherlands, and Poland, responsibilities within certain policy domains (spatial planning; emergency management) are divided between a number of actors at different administrative levels. In most cases there are also hierarchical relations between these actors.⁵¹ This form of ‘vertical’ fragmentation can be considered a specific form of ‘Type 2’ fragmentation (see Tables 4.2 and 4.4). Another particular form of ‘Type 2’ fragmentation – that, for the sake of clarity, has not been included in the tables below, but is nonetheless worth mentioning –, can be referred to as ‘areal’ fragmentation. This form of fragmentation emerges where the same type of actors (local or regional authorities) have the same type of responsibilities and competences for governing distinct (neighboring) areas. This form of fragmentation, can be seen as resulting from decentralization and is highly common across the selected and other decentralized countries.

England (UK)

Policy domain	Main Actors	FRM strategy/strategies
Spatial planning	<ul style="list-style-type: none"> • Department for Communities and Local Government (DCLG) • Local Planning Authorities • Planning Applicant or Developer 	Prevention
Flood defense/mitigation	<ul style="list-style-type: none"> • Lead Local Flood Authorities (LLFA) • Environment Agency (EA) • Department for Environment, Food and Rural Affairs (Defra) • Regional Flood and Coastal Committees (RFCC) • Riparian owners • Highways Agency • Water companies • Internal Drainage Boards • A range of other (private) actors may be contracted under new partnership agreements 	Defense/mitigation
Emergency management	<ul style="list-style-type: none"> • Category 1 responders (emergency services, EA, and Local Authorities (LAs)) • Category 2 responders (utility companies, telecommunications, transport operators, Health and Safety Executive, NHS Trust Development Authority) • Government departments involved in emergency response: Defra, DCLG, Civil Contingencies Secretariat (CCS) • Met Office • Flood Forecasting Centre • Voluntary sector 	Preparation & response

Table 3.1: Main actors in selected policy domains within the English FRM system

Type of fragmentation	Actor sets/groups and strategies
Type 1 (distinct domains; different strategies)	<ul style="list-style-type: none"> • All actors within flood defense/mitigation and Spatial Planning domains (<i>defense/mitigation – prevention</i>)
Type 2 (same domain; same strategy)	<ul style="list-style-type: none"> • All actors within Spatial Planning domain (<i>prevention</i>) • All actors within Emergency Management domain (e.g. Category 1 and Category 2 Responders) (<i>preparation & response</i>) • All actors within flood defense/mitigation as they have responsibilities for both strategies (<i>defense/mitigation</i>)
Type 3 (distinct domains; same strategy)	<ul style="list-style-type: none"> • Although community engagement (as part of the preparation & response strategy) is mainly performed within emergency management activities, a range of other methods are employed external to this and involve different actors from other policy domains (<i>preparation & response</i>)

Table 4.1: Examples of different types of fragmentation within the FRM system in England (UK)

⁵¹ See, for instance, Korsse 2014.

Flanders (Belgium)

Policy domain	Main actor(s)	FRM strategy/strategies
Water Management	Water Managers	Defense; prevention; mitigation
Spatial Planning	Spatial Planning Authorities (at different administrative levels)	Prevention; mitigation
Emergency Management	Emergency Management Authorities; emergency services; volunteers	Preparation & response

Table 3.2: Main actors in selected policy domains within the Flemish FRM system

Type of fragmentation	Actor sets/groups and strategies
Type 1 (distinct domains; different strategies)	<ul style="list-style-type: none"> Water Managers – Spatial Planners (<i>defense – mitigation/prevention</i>) Water Managers – Emergency Managers (<i>defense – preparation & response</i>) Spatial Planners – Emergency Managers (<i>mitigation/prevention – preparation & response</i>)
Type 2 (same domain; same strategy)	<ul style="list-style-type: none"> Actors at different administrative levels within spatial planning domain (<i>mitigation/prevention</i>) Emergency Authorities – Emergency Services (<i>preparation & response</i>) Different actors within Water Management Domain (<i>defense/prevention/mitigation</i>)

Table 4.2: Examples of different types of fragmentation within the FRM system in the Flemish Region (Belgium)

France

Policy domain	Main actor(s)	FRM strategy/strategies
Natural risk management	Natural Risk Management Authorities (State)	Defense; prevention; mitigation
Spatial Planning	Spatial Planning Authorities	Prevention; mitigation
Emergency Management	<ul style="list-style-type: none"> Emergency Management Authorities Emergency Services 	Preparation & response
Water management	Water Management Authorities	Mitigation; defense
Water and flood management (emerging policy domain)	Municipalities	Defense; mitigation

Table 3.3: Main actors in selected policy domains within the French FRM system

Type of fragmentation	Actor sets/groups and strategies
Type 1 (distinct domains; different strategies)	<ul style="list-style-type: none"> Natural Risk Management Authorities – Spatial Planning Authorities (<i>defense – prevention/mitigation</i>) Water Management Authorities – Spatial Planning Authorities (<i>defense – prevention/mitigation</i>) Natural Risk Management Authorities – Emergency Management Authorities (<i>defense/prevention/mitigation – preparation & response</i>) Water Management Authorities – Emergency Management Authorities (<i>defense/mitigation – preparation & response</i>) Emergency Management Authorities – Spatial Planning Authorities (<i>preparation & response – prevention/mitigation</i>)
Type 2 (same domain; same strategy)	<ul style="list-style-type: none"> Different actors within civil security domain (<i>preparation & response</i>)
Type 3 (distinct domains; same strategy)	<ul style="list-style-type: none"> Natural Risk Management Authorities – Spatial Planning Authorities (<i>prevention</i>) Natural Risk Management Authorities – Spatial Planning Authorities (<i>mitigation</i>) Natural Risk Management Authorities – Water Management Authorities (<i>defense</i>) Natural Risk Management Authorities – Water Management Authorities (<i>mitigation</i>) Water Management Authorities – Spatial Planning Authorities (<i>mitigation</i>)

Table 4.3: Examples of different types of fragmentation within the FRM system in France

The Netherlands

Policy domain	Main actor(s)	FRM strategy/strategies
Water System Management	Water Management Authorities	Defense; mitigation; preparation & response
Spatial Planning	Spatial Planning Authorities (at different administrative levels)	Prevention/mitigation
Emergency Management	<ul style="list-style-type: none"> Emergency Management Authorities Emergency services Utility providers Volunteers 	Preparation & response

Table 3.4: Main actors in selected policy domains within the Dutch FRM system

Type of fragmentation	Actor sets/groups and strategies
Type 1 (distinct domains; different strategies)	<ul style="list-style-type: none"> Water Management Authorities – Spatial Planning Authorities (<i>defense – mitigation/prevention</i>) Spatial Planning Authorities – Emergency Management Authorities (<i>mitigation/prevention – preparation & response</i>) Water Management Authorities – Emergency Management Authorities (<i>defense – preparation & response</i>; also see below)
Type 2 (same domain; same strategy)	<ul style="list-style-type: none"> Actors at different administrative levels within spatial planning domain (<i>mitigation/prevention</i>) All relevant actors within EM domain (<i>preparation & response</i>)
Type 3 (distinct domains; same strategy)	<ul style="list-style-type: none"> Emergency Management Authorities – Water Management Authorities (as far as <i>preparation & response</i> is concerned)

Table 4.4: Examples of different types of fragmentation within the FRM system in the Netherlands

Poland

Policy domain	Main actor(s)	FRM strategy/strategies
Water Management	<ul style="list-style-type: none"> Regional Water Management Boards Provincial Authorities for Drainage, Irrigation and Infrastructure 	Defense; preparation & response
Spatial Planning	Municipal Spatial Planning Authorities	Prevention/mitigation
Crisis Management	<ul style="list-style-type: none"> Emergency Management Authorities (at different administrative levels) State Fire Brigades and other emergency services Institute for Meteorology and Water Management 	Preparation & response

Table 3.5: Main actors in selected policy domains within the Polish FRM system

Type of fragmentation	Actor sets/groups and strategies
Type 1 (distinct domains; different strategies)	<ul style="list-style-type: none"> Regional Water Management Boards – Municipal Spatial Planning Authorities (<i>defense – mitigation/prevention</i>) Municipal Spatial Planning Authorities – Emergency Management Authorities (<i>mitigation/prevention – preparation & response</i>)
Type 2 (same domain; same strategy)	<ul style="list-style-type: none"> Relevant actors within crisis management domain (<i>preparation & response</i>)
Type 3 (distinct domains; same strategy)	<ul style="list-style-type: none"> Provincial Authorities for Drainage, Irrigation and Infrastructure – Emergency Management Authorities (<i>preparation & response</i>)

Table 4.5: Examples of different types of fragmentation within the FRM system in Poland

4.2. Bridging mechanisms in the selected countries

Having presented examples of the degrees and types of fragmentation in the selected countries in the previous section, this section focuses on types of bridging mechanisms present in those countries. It should be mentioned here that it is impossible, within the scope of one paper, to give a full view and an in-depth description of all bridging mechanisms present, let alone to thoroughly evaluate the degree and quality of the interconnectedness within the selected countries' FRM systems. Instead, a number of examples are presented

below (Tables 5.1 to 5.5). For further evaluations of the interconnectedness within domestic FRM systems, the evaluation framework presented in Section 5 is recommended, as specifically developed for this purpose.

In all countries, the relations between actors within the spatial planning domain and the domain of flood/water management⁵² is considered a form of ‘Type 1’ fragmentation, as different actors or actor groups operating in distinct policy domains pursue different strategies. In order to resolve potential difficulties resulting therefrom, all countries have implemented specific transfer mechanisms. Moreover, most countries – except for Poland and France – have also implemented coordination mechanisms (see Tables 5.1 to 5.5). It is striking that all transfer mechanisms, although highly different in nature, appear as advisory or consulting structures on the basis of which actors specialized in FRM have advising or consulting roles in spatial decision making. Well known examples are the Dutch⁵³ and Flemish⁵⁴ variants of the ‘Water Test’, but similar statutory structures are present in England,⁵⁵ France,⁵⁶ and Poland.⁵⁷ Coordination mechanisms vary from general statutory obligations to align spatial and water policies (the Netherlands),⁵⁸ to the establishment of specialized coordination committees (Flanders),⁵⁹ and the continued coordinating effects of the advisory/consulting mechanisms mentioned (England and Flanders).⁶⁰

An evident form of ‘Type 2’ fragmentation in all selected countries are the relations between relevant actors within the emergency management policy domain. Also in this respect, the distinct countries have developed highly different arrangements,⁶¹ but the degree of interconnectedness at first glance can be considered optimal, as all countries have implemented specific transfer, coordination, as well as cooperation mechanisms (see Table 5.1 to 5.5). Transfer mechanisms range from statutory duties to share information (England), to information exchange structures in the framework of established committees or crisis centres (Flanders, Poland), and different types of consultation or participation structures (France, the Netherlands). Coordination mechanisms are also varied, as coordination in some countries is promoted through specific (resilience) fora, committees or crisis centres (England, Flanders), whereas in other countries this is mainly done through alignment of strategic and operational policies (France, the Netherlands). Also cooperation structures vary from statutory duties to cooperate (England), to (ad-hoc or formalized) cooperation in the framework of specific institutions (Poland, Belgium), periodical exercises (France) and/or semi-formal instruments, such as covenants (the Netherlands).

⁵² These policy domains are referred to differently in the selected countries.

⁵³ See Groothuijse & Van Rijswijk 2005; Groothuijse 2009; Van Rijswijk & Havekes 2012; Gilissen, Kevelam & Van Rijswijk 2014; OECD 2014; Van Rijswijk 2014; and Kaufmann et al. 2015.

⁵⁴ See Denys & Toury 2012; Ameloot 2013; Carette & De Smedt 2013; and Mees et al. 2015.

⁵⁵ See Alexander et al. 2015.

⁵⁶ See Larrue et al. 2015.

⁵⁷ See Matczak et al. 2015.

⁵⁸ See Havekes & De Putter 2014.

⁵⁹ See De Smedt 2003; and Carette & De Smedt 2013.

⁶⁰ See Alexander et al. 2015; and Mees et al. 2015.

⁶¹ See Gilissen et al. 2016a.

A specific form of ‘Type 3’ fragmentation emerges in England, the Netherlands and Poland, as in these countries distinct actors operating within distinct policy domains pursue the preparation & response strategy with different means (see Tables 5.1, 5.4 and 5.5). Only in the Netherlands, transfer and coordination mechanisms in this respect have a firm legal basis. Information transfer is promoted through consultation and the formal role of Water Management Authorities in the Security Regions’ board meetings. Coordination is fostered through the compulsory alignment of strategic and operational emergency plans of relevant Water Management Authorities and Emergency Management Authorities. Cooperation, in the Netherlands, largely takes place on an informal basis (e.g. cooperation in the organization of periodical exercises), although formalization has been considered in the past.⁶² In England, although the emergency management as such is highly formalized, information transfer and coordination mechanisms between actors within the strict emergency management domain and other relevant actors operating in other domains have not been formalized. However, their activities are mostly coordinated on a more informal basis.

England

	Type 1: Prevention and defense/mitigation	Type 2: Emergency management (preparation & response)	Type 3: Preparation & response (more broadly)
Transfer	The EA and LLFAs are statutory consultees for spatial planning decision-making for large-scale developments; Flood Risk Standing Advice is also provided by the EA for small-scale developments (Town and Country Planning (Development Management Procedure) (England) Order 2010)	All Category 1 and 2 Responders have statutory duties to share information (and cooperate) (Civil Contingencies Act (Contingency Planning) Regulations 2005)	Informal information exchange between relevant actors in order to coordinate activities
Coordination	The National planning policy framework sets out mechanisms to prevent inappropriate development in at-risk areas (i.e. Sequential and Exception tests)	Category 1 Responders are required to form Local Resilience Forums (LRFs), integrating/coordinating policies, and must attend regular meetings to facilitate multi-agency, joined-up working, with the support of Category 2 Responders (Civil Contingencies Act (Contingency Planning) Regulations 2005)	Although community engagement activities can be performed within the FRM policy domain or civil contingencies policy domain, these activities are often coordinated, or at least delivered in a way that is mutually-beneficial
Cooperation	N/A	All Category 1 and 2 Responders have statutory duties to cooperate (and share information) (Civil Contingencies Act (Contingency Planning) Regulations 2005)	No clear arrangement

Table 5.1: Examples of bridging mechanisms addressing fragmentation within the English FRM system

⁶² See Havekes & De Putter 2014, p. 164.

Flanders (Belgium)

	Type 1: Defense and prevention/mitigation	Type 2: Emergency management (preparation & response)
Transfer	Water Test (statutory advisory mechanism) (Decree Integrated Water Policy 2003)	Municipal/provincial level: Information transfer between relevant actors within 'Safety Cells' (Royal Decree of 16 February 2006) Federal level: Coordination and Crisis Centre of the Government (Royal Decree of 18 April 1988)
Coordination	Coordination through Water Test and the Coordination Committee on Integrated Water Policy (CIW) (Decree Integrated Water Policy 2003)	Municipal/provincial level: Coordination through 'Safety Cells' and coordination committees (Royal Decree of 16 February 2006) Federal level: coordination by the Coordination and Crisis Centre of the Government (Royal Decree of 18 April 1988)
Cooperation	N/A	Municipal/provincial level: cooperation through 'Safety Cells' (Royal Decree of 16 February 2006) Federal level: cooperation through the Coordination and Crisis Centre of the Government (Royal Decree of 18 April 1988)

Table 5.2: Examples of bridging mechanisms addressing fragmentation within the Flemish FRM system

France

	Type 1: Defense and prevention/mitigation	Type 2: Emergency management (preparation & response)	Type 3: Defense/mitigation
Transfer	Formal consultation of SPAs during decision processes led by the NRMAs; informal transfer of information (e.g. dialogues between authorities)	Formal role of State authorities in security regional board meetings, and consultation in strategic emergency planning	
Coordination	No clear arrangement	Compulsory alignment of strategic and operational emergency planning	Compulsory alignment of water management planning, spatial planning and water infrastructures development; River Contracts (coordinated non-binding multi-actor water management programs)
Cooperation	N/A	Exercises and simulations involving a plurality of actors	Cooperation through Water Boards

Table 5.3: Examples of bridging mechanisms addressing fragmentation within the French FRM system

The Netherlands

	Type 1: Defense and prevention/mitigation	Type 2: Emergency management (preparation & response)	Type 3: Preparation & response (focusing on relations between WMAs and EMAs)
Transfer	Water Test (statutory advisory mechanism) (Spatial Planning Decree 2008)	Participation of relevant actors in Security Regions' board meetings and specific communication channels during emergency situations (Security Regions Act 2010)	Formal role of WMAs in Security Regions' board meetings, and consultation in strategic emergency planning (Security Regions Act 2010)
Coordination	General coordination duty between WMA and SPA policies (Water Act 2009)	Coordination through generic operational emergency planning and Coordinating Teams at different operational and administrative levels (Security Regions Act 2010)	Compulsory alignment of strategic and operational emergency planning (Security Regions Act 2010/Water Act 2009)
Cooperation	N/A	Covenants between EMAs and utility providers (informal, but 'good practice')	Largely on informal basis (e.g. exercising), although formalization was considered

Table 5.4: Examples of bridging mechanisms addressing fragmentation within the Dutch FRM system

Poland

	Type 1: Defense and mitigation/prevention	Type 2: Crisis management (preparation & response)	Type 3: Preparation & response (focusing on relations between Provincial Authorities and EMAs)
Transfer	Formal consultation of Regional Water Management Boards in municipal (local) spatial planning (Water Act 2001 and Spatial Planning and Development Act 2003)	Crisis Management Centres and Teams (municipal, county and provincial levels)	Crisis Management Centres Teams (municipal, county and provincial levels)
Coordination	No clear arrangement	IT System for Protection against Extraordinary Hazards	Coordination through Crisis Management Centres (at municipal, county and provincial levels)
Cooperation	N/A	National Rescue and Firefighting System	N/A

Table 5.5: Examples of bridging mechanisms addressing fragmentation within the Polish FRM system

5. Evaluation framework: a seven-step method for future research

Although the data presented above give an impression of the degree of fragmentation and the bridging mechanisms established in order to facilitate interconnectedness within the selected countries, on the basis thereof no firm conclusions can yet be drawn about the interconnectedness within these countries' FRM systems. A full overview and an analysis of the quality of interconnectedness within these countries' FRM systems require comprehensive, structured and more in-depth system evaluations. Since such a framework has not yet been developed, this section presents an interdisciplinary methodological framework for the evaluation of the interconnectedness within domestic FRM systems through seven successive steps. Rooted in the conceptual and empirical analyses above, this methodological framework is meant as a guideline for further research.⁶³ A pragmatic, flexible and broadly applicable research tool, this framework can prove useful for both academic and practical purposes (e.g. concept development, system evaluations, and system

⁶³ Inspiration for this framework was drawn from Runhaar et al. 2014; Runhaar et al. 2015; Gilissen et al. 2015; and Gilissen et al. 2016b.

(re)development). This novel method comprises seven successive steps, arranged into three research phases: 1) the preparatory and analytical phase, 2) the evaluation phase, and 3) the phase of reflection and drawing conclusions. In Tables 6.1 to 6.3, the successive steps within these phases are schematically presented and shortly exemplified. Also specific research techniques are suggested where relevant.

Phase 1) Preparation and analysis

The preparatory and analytical phase aims at ‘setting the scene’ and analyzing and arranging all relevant information in order to perform the evaluation in a structured manner.⁶⁴ This phase comprises three steps. It mainly requires in-depth system analysis, including literature review, analysis of legislation, explanatory memoranda and policy documents, and perhaps stakeholder/expert involvement through interviews and focus group sessions.⁶⁵

Successive steps	Exemplification	Suggested research techniques
Step 1) Description of the selected FRM system	<ul style="list-style-type: none"> Describe the selected FRM system, focusing on its characteristics, its implemented strategies, the relations between strategies, the policy domains, and the relevant actors, including their responsibilities and competences 	In-depth system analysis through: <ul style="list-style-type: none"> Literature review Analysis of legislation, explanatory memoranda, and policy documents Interviews/focus groups
Step 2) Determination of the degree of fragmentation	<ul style="list-style-type: none"> Schematically arrange the information from step 1 Determine (the amount of) actor sets (for examples, see Tables 3.1 to 3.5) and the degree of fragmentation 	
Step 3) Determination of types of fragmentation	<ul style="list-style-type: none"> Determine the type of fragmentation for every identified actor set on the basis of Figure 2 Schematically present the findings (for examples, see Tables 3.1 to 3.5) 	

Table 6.1: The preparatory and analytical phase

Phase 2) Evaluation

The evaluation phase forms the core of this evaluation framework. It comprises two steps, mainly building upon the information gathered and arranged during the previous phase/steps. Apart from in-depth system and situation analysis, this phase requires the selection and operationalization of evaluation criteria for assessing the effectiveness of specific arrangements, in this case indicators and/or benchmarks for evaluating the effectiveness of bridging mechanisms. Apart from the suggestions for evaluation criteria presented in Section 3.3, further developing and enriching the set of evaluation criteria may require further studies into (methodological) literature.⁶⁶

⁶⁴ If the evaluation, moreover, is part of a comparative research project, a structured framework could optimize comparative potential. See, for instance, Azarian 2011.

⁶⁵ See, for instance, Morgan 1996; Wilson 2012a; Wilson 2012b; Säynäjoki et al. 2014; and Runhaar et al. 2015, pp. 8-9.

⁶⁶ See, for instance, Adger et al. 2005; Van Rijswijk & Salet 2012; Van Buuren et al. 2014; Hegger et al. 2014; Mees et al. 2014; and Runhaar et al. 2015, p. 4.

Successive steps	Exemplification	Suggested research techniques
Step 4) Identification of bridging mechanisms and ‘gaps’	<ul style="list-style-type: none"> • Determine the presence and types of bridging mechanisms for every actor set (as identified in steps 2 and 3), using Table 2 as a ‘searching tool’ • Identify ‘gaps’ (i.e. does the situation meet the ‘ideal-typical’ situation depicted in Table 2?) • Determine the degree of interconnectedness (i.e. to which extent are all actor sets interconnected through specific bridging mechanisms?) • Describe the identified bridging mechanisms, focusing on their goals and (legal) characteristics 	In-depth system and situation analysis through: <ul style="list-style-type: none"> • Literature review • Analysis of legislation, explanatory memoranda, and policy documents • Case studies • Interviews/focus groups
Step 5) Evaluation and explanation of the results	<ul style="list-style-type: none"> • Evaluate the effectiveness of the identified bridging mechanisms, at least following the criteria of explicitness, enforceability, and legitimacy (Section 3.3) • Explain the ‘gaps’ identified in step 4 • Determine the quality of interconnectedness (i.e. to which extent are the identified bridging mechanisms effective themselves?) 	Further substantiation of finding through: <ul style="list-style-type: none"> • Additional desk research • Additional case studies • Additional interviews/focus groups • Refining the method through, for instance, introducing new indicators or specific benchmarks per indicator

Table 6.2: The evaluation phase

Phase 3) Conclusions, recommendations and reflection

The concluding phase comprises two steps. Apart from drawing conclusions about the degree and quality of the interconnectedness within (and, thus the effectiveness of) an FRM system and, if necessary, formulating recommendations for improvement, the applied method should also be reflected upon itself for refining purposes. In case of cross-country comparisons, the transferability of identified ‘good practices’ can be assessed. It should be kept in mind, however, that bridging mechanisms or practices proving effective in the one country, are not necessarily as effective in another cultural, political, institutional and normative setting.

Successive steps	Exemplification	Suggested research techniques
Step 6) Conclusions and recommendations	<ul style="list-style-type: none"> • Draw conclusions about the effectiveness of FRM through the lens of interconnectedness • Give recommendations (e.g. should at some point(s) in the system specific types of bridging mechanisms be implemented; or could the effectiveness of specific bridging mechanisms be improved?) • Could identified ‘good practices’ be transferred to other systems? 	
Step 7) Reflection/refinement of the method	<ul style="list-style-type: none"> • Reflect upon the practical application of the method (e.g. what went wrong; what was unclear; where did we get stuck; how can this be solved?) • Reflect upon unexpected outcomes (e.g. a new type of bridging mechanisms appeared) • Improve the method based on the findings above 	

Table 6.3: The concluding phase

6. Conclusions

Diversification of FRM strategies is assumed to enhance societal resilience to flooding and, thus, the effectiveness of FRM. In this paper, this assumption is nuanced. Acknowledging that diversification indeed is desirable, this paper focuses on fragmentation of domestic FRM systems as one of its inevitable side-effects, which can potentially be detrimental to the effectiveness of FRM. This paper, therefore, claims that resolving the difficulties relating to fragmentation through increasing the interconnectedness between relevant actors within fragmented domestic FRM systems is yet another condition for FRM to be effective. The instruments suited for this purpose are metaphorically referred to as bridging mechanisms. From the perspective of specific difficulties relating to fragmentation, three types of bridging mechanisms can be discerned, namely transfer mechanisms, coordination mechanisms, and cooperation mechanisms.

On the basis of the identification of both degrees and types of fragmentation and their relating difficulties, specific points within FRM systems can be identified on which specific types of bridging mechanisms are needed. Having the appropriate types of bridging mechanisms implemented on the relevant points within an FRM system leads to an optimal degree of interconnectedness. Apart therefrom, also the quality of interconnectedness is key in order to optimally contribute to the effectiveness of FRM as such and, thus, enhance societal resilience to flooding. All bridging mechanisms within an FRM system should, in other words, be effective themselves as well. The effectiveness of bridging mechanisms can be determined following a mixed set of legal and extra-legal indicators, such as transparency, enforceability, and legitimacy.

Building upon empirical research conducted within the framework of the EU project ‘STAR-FLOOD’, this paper shows that – despite a number of similarities – both the degrees and types of fragmentation within the selected countries’ FRM systems differ. Compared to Belgium, the Netherlands, and Poland, the overall degree of fragmentation can be considered rather high in England and France. In the former countries a limited number of policy domains are rather straightforwardly distinguished in which one or a few actors bear responsibilities for the pursuit of single or a limited number of FRM strategies. In the latter, such responsibilities per policy domain are divided between a large number of actors (England), or multiple actors operating in different policy domains are partly responsible for the pursuit of the same strategy (France). This leads to the conclusion that there are more points within the English and French FRM systems that need bridging mechanisms, than in the other countries.

Although three out of four types of fragmentation are present within all selected countries’ FRM systems, the overall differences in degrees of fragmentation also result into differences regarding the dominance of a specific type of fragmentation per country. This paper shows that in England and France more ‘complex’ types of fragmentation (‘Type 2’ and ‘Type 3’, respectively) are dominant, whereas in the other countries a ‘simple’ type of fragmentation (‘Type 1’) is more common. As a striking similarity, all countries’ emergency management arrangements, however, can be considered more complex through the lens of fragmentation (‘Type 2’). Although this does not say much about the effectiveness of FRM in the respective countries, it should be noted that at the points where more complex types of fragmentation

are present, also a wider range of bridging mechanisms is needed. Whereas, in terms of this paper, in simple situations transfer and coordination mechanisms suffice, in more complex situations there is an additional need for cooperation mechanisms.

An investigation of a selection of types of fragmentation present in the selected countries shows that these countries have bridging mechanisms in place at (most) relevant points within their FRM systems. In general, in complex situations of fragmentation, these countries indeed have implemented specific cooperation mechanisms in addition to transfer and coordination mechanisms. Unsurprisingly, all specific bridging mechanisms highly differ as to their nature and degree of formality across the selected countries. Nonetheless, there are similarities, for instance within the field of spatial planning, where all countries have implemented some formalized form of advisory or consulting mechanisms similar to the Dutch and Flemish ‘Water Test’. Although some blank and unclear spots remain, the overall impression is that the degree of interconnectedness within the selected countries – at least regarding the investigated selection of situations of fragmentation – can be considered adequate, if not optimal.

Despite the positive tenor of the above, it is yet too early to conclude that all difficulties relating to fragmentation are properly taken care of, and that the selected countries’ FRM systems, thus, can be considered effective. This is something we just do not and cannot know at this stage, simply because there is too little information about the effectiveness of all bridging mechanisms in place, and thus about the quality of the interconnectedness. In order to draw such conclusions, the effectiveness of every single bridging mechanisms should be analyzed and the results thereof should be reflected upon. Here lies one of the major challenges for future FRM research. Rooted in its conceptual contemplations and aiming to facilitate such future research, this paper therefore outlines a novel interdisciplinary methodological framework for evaluating the interconnectedness within domestic FRM systems. Given its cross-country comparative potential, the societal issues relating to FRM at stake, and the overwhelming amount of work to be done, diversification, fragmentation, interconnectedness and the presented evaluation framework could easily be at the basis of a follow-up interdisciplinary research project. This is an open invitation; there still are many troubled waters to be bridged.

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